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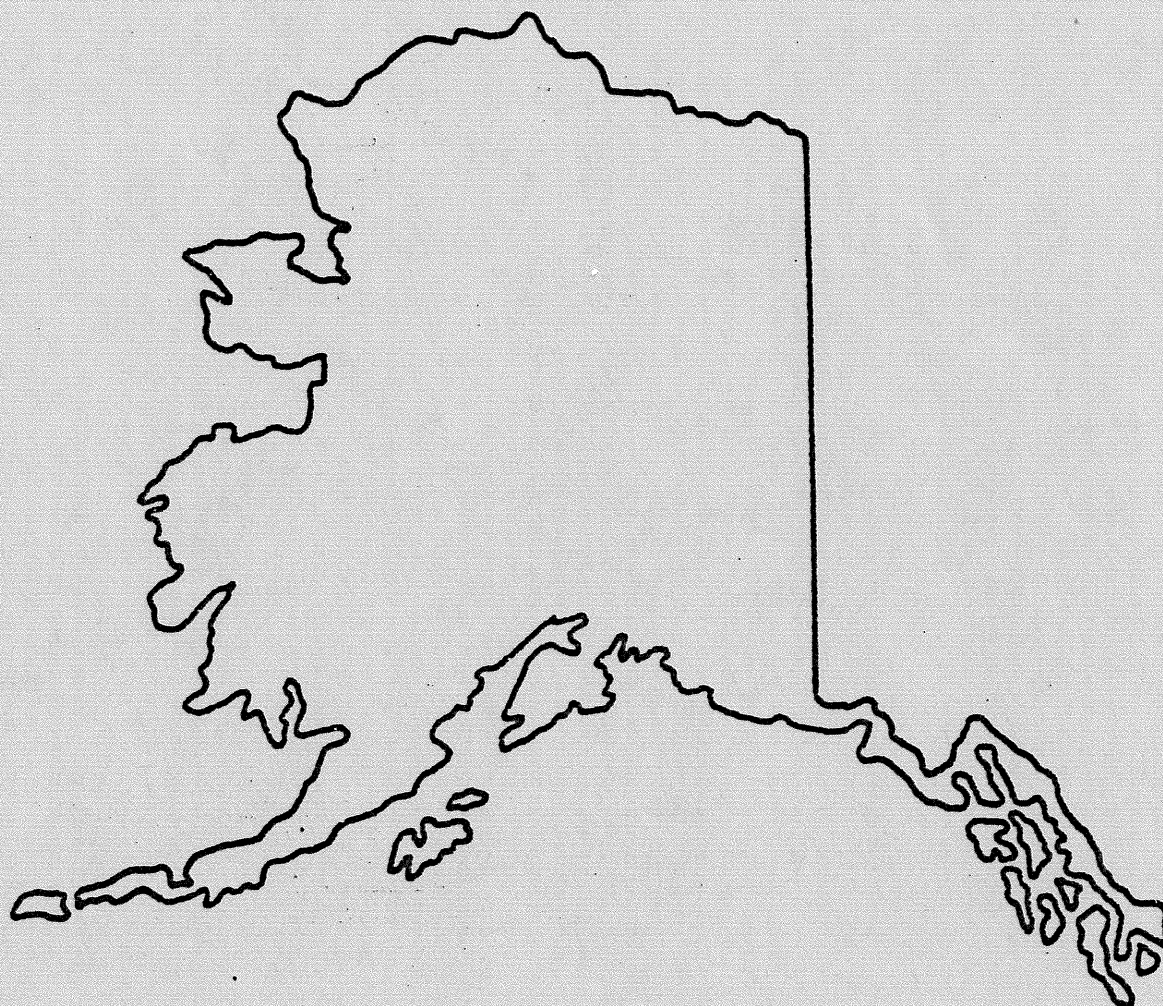


Forest Pest Management Report

BIOLOGICAL EVALUATION R10-90-5

VEGETATION MANAGEMENT IN THE COOPER
LANDING AREA, CHUGACH NATIONAL FOREST

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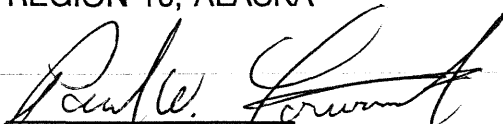
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Vegetation Management in the Rehabilitation of the
Cooper Landing Beetle Outbreak Area
Chugach National Forest, Seward, Alaska

by

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ABSTRACT

Large-scale mortality of spruce forests in the upper Kenai River area of Alaska is creating severe fire hazards. Vegetation developing on beetle-kill areas reduces the probability of desirable natural regeneration or successful planting. It also helps create more continuity of flashy fuel.

Silvicultural prescriptions are outlined to achieve three sets of vegetation and general management goals. They are presented in reference to eight specific criteria generally accepted to be central to public concerns over forestry activities. The prescriptions entail use of a wide array of silvicultural tools, all of which are presumed to be available if they meet these criteria. Several options appear feasible for meeting multiple-use objectives in this area.

Introduction

The spruce beetle epidemic in the upper reaches of the Kenai River in the Chugach National Forest and intermingled state and private lands is causing nearly total mortality in spruce stands. These stands range from

commercially harvestable areas with 10,000 to 15,000 BF/acre at low elevations to alpine areas with no commercial value, but substantial aesthetic appeal. The epidemic is centered in the Cooper Landing area, where approximately 27,000 acres of potentially salvageable forests have sustained heavy mortality already. The epidemic is apparently moving upriver, and substantially more acreage is expected to be similarly affected.

The spruce beetle can be controlled by spraying individual trees with insecticide. While this may be feasible for such high-value trees as those in campgrounds, there is no practical possibility for protecting the forest-at-large at this time.

The spruce beetle is a native insect. It tends to develop epidemics in mature stands whose vigor is declining because of overmaturity. Several years are required for an epidemic to run its course.

During an epidemic, dominant trees, followed by progressively smaller trees, are attacked. Seed source trees with full crowns are killed, and opportunities for natural regeneration are compromised. The lack of physical disturbance decreases seedbed quality, and pre-existing understory species are released, often without an established crop of spruce seedlings among them. Although the tolerant white and Lutz spruces can eventually re-appear, distribution and growth of seedlings are normally poor. Such regeneration is likely to develop into insect-vulnerable stands of the type presently supporting the epidemic.

The beetle epidemic and subsequent invasion of forest sites by Calamagrostis grass leads to explosive fuel conditions, and also to the need for extensive salvage logging to reduce fuel and conserve decaying timber. The timber value and risk of conflagration near the Cooper Landing community make the area a top priority for large-scale forest

rehabilitation. The scale of need for both harvest and reforestation is unprecedented in the Chugach N.F. and highly creative measures will be necessary to deal with the current emergency.

This report outlines some features of plant development in beetle-killed stands, and describes some vegetation management/harvesting options and subsequent reforestation measures adaptable to this area.

Plant succession, competition, and reforestation

The occurrence of competitive plant cover during a beetle attack is variable. Pre-existing understories can be expected to become much more vigorous. On rich, low elevation sites, open stands typically contain understories of Sitka alder and grass. These are most common where there is a substantial component of birch in the overstory. As mortality opens the canopy, grass, alder, and other shrubs such as Menziesia and Vaccinium species increase in abundance and density.

Rich sites on which overstories have been solid stands of spruce often have little grass to start with, and provide a poor germination medium until dead trees begin to blow down, exposing root wads and root craters of mineral soil. These stands therefore are not likely to be overtaken by grass quickly unless otherwise disturbed. Nevertheless, Calamagrostis is rhizomatous and a small population of seedling grass can spread quickly once established. Thus, provision for regeneration is a matter of some urgency in order to avoid the competitive effects of the grass.

Poorer sites, e.g., stands on dry south slopes, gravelly soils, etc. appear less amenable to grass invasion. The characteristics of these sites are not known fully to this observer; but some relatively simple

grouping of habitat types should provide a reasonable system for segregating sites into those with serious vs. minor grass threat. Habitat classifications for grass threat after beetle kill should be a high priority for immediate action.

Most of the Cooper Landing area that has not been burned severely in the recent past has a heavy organic layer. This layer is usually occupied by mosses, crowberry, Vaccinium, and numerous perennial herbs. Root densities are extremely high, and this layer is both flammable when dry or under intense fuel loading. It is cold and wet in spring but is subject to drying in midsummer in the absence of rain. Thus, it is a fire hazard under prolonged warm, dry conditions, but a nearly fire-proof physical/biological impediment to regeneration much of the time. While the duff layer restricts conifer regeneration, it also resists invasion by other light-seeded species, so that unbroken duff remains relatively free of immigrant species for some time after beetle mortality except where occupied by rhizomatous grass from scattered seedlings. It thus may have some role in controlling weeds, and can be a suitable medium for planting if not occupied by transpiring vegetation.

The fire history of the Cooper Landing area is noteworthy. Wildfires and prescribed fires for moose habitat rejuvenation reveal some patterns which, though causes are not clear at present, could be very useful in regeneration planning. Typically, the major fire season focuses in early summer, before grass green-up. The dead thatch of previous years' grass is flashy fuel. Dead spruce contributes much fine fuel after it is down. The insulating properties of the duff keep it cold and wet in the early

season, and early burns tend not to remove the duff unless the spruce has been felled or otherwise made into a packed fuel layer with ability to sustain the heat source until duff is hot and dried out.

It is our impression that fires somewhat later in summer could be done deliberately when duff is drier and more able to support its own fire. Intense heat in the duff appears able to kill the rhizomatous species that appear the strongest competitors (i.e., grass, fireweed) and also provide a better seedbed for spruce, birch, and willow. Obviously, measures to make such a burn both feasible and controllable may be necessary to desiccation.

A site classification that can predict where the major competition problems will occur include:

1. Rich, low elevation vs. poorer sites
2. Sites with established grass, fireweed vs. not established
3. Cold vs. warm sites (i.e., when burning will kill rhizomes)

We believe that GIS data currently available, together with ground truth by a competent ecologist/silviculturist, could categorize these sites quickly and effectively. An additional category would relate to ease and safety of burning (prescribed).

Response of vegetation to disturbance

The explosive fire hazard in the Cooper Landing area demands immediate attention on a very large scale. In the next several years, it will be necessary to log the timber that is still salvageable. Beyond that time, salvage value will be submarginal, and tens of millions of board feet will become unsalvageable, and the economic lever for operating

to reduce fuel hazard will be lost. This would necessitate prohibitively expensive, massive fuel reduction treatments as a capital investment.

Salvage will entail both summer and winter logging. Where logging is done in winter, duff will be largely undisturbed, and one may expect release of existing vegetation, but comparatively little seeding in. Advanced regeneration, if any, will survive, but little additional seeding can be expected soon. If there is any grass distributed in such areas, and the sites are apparently capable of supporting grass stands, a dense grass/fireweed mixture can be expected in one or two years. If no grass is now present, arrival and spread will take longer, but shrubs will become more prevalent.

Summer logging on grass-threat sites will probably promote much more rapid grass development. Disruption of duff creates a desirable seedbed not only for spruce, but for birch, willow, grass and fireweed. On rich sites, the rapid colonization by herbs can be expected to stabilize the site against further seeding of woody species. The severity of this problem is almost certain to be proportional to the site quality, and this problem will be most prevalent on commercially operable sites.

Many sites will need to be burned for hazard reduction. Some of these will have been logged first. Hot, summer burns, or spring burns with heavy fuel will deplete the root systems of many of the pre-existing potential competitors. Light burns will probably stimulate the same species, hence careful distinction must be made between conditions that do or do not remove competitors. There is widespread evidence that fire can be beneficial or harmful to the cause of competition management. Careful documentation will be needed to determine what condition proves above and below the threshold for root kill.

Fires intense enough to kill competitors will also remove some or all the duff layer. An analysis of the impact of such burning on long term site productivity would be appropriate.

Much of the logging at present leaves residual seed sources of birch, but little source of spruce. Where there is some surface disturbance, the density of birch may be too great to also support spruce or willow. This may or may not be a problem, depending on local goals.

At present, the importance of competing vegetation to spruce, birch, and willow cannot be described in quantitative terms. Data from other regions make clear that dominant grasses and shrubs are strong competitors. Impact of competing vegetation is also probably related to the difference in height of competitor and desirable species. Thus, grasses/shrubs may completely inhibit seed development under conditions where small container seedlings may survive, but have very slow growth for five-ten years. Under the same cover conditions, advanced regeneration above the competition may be scarcely affected by it, and even benefited by lack of invader-potential for overstocking. Thus, grass/herb development is crucial where a) artificial regeneration is planned, b) fire hazard is augmented by fine fuels, and c) moose browse will be inhibited. It is not crucial on unmanaged land and areas of low fire concern.

Competing vegetation is never static. The occurrence of beetle mortality for several years before entry often provides for a well established competitor community before logging, burning, or fire break construction. Under these conditions, a strong competitor community will merely be stimulated by logging unless deep scarification is done and

perhaps even then. The use of deep scarification is probably not feasible on a large scale for logistic reasons. Moreover, this practice is effective for competition control partly because it removes the fertile duff and A₁ soil horizons. Where good fertility is not compromised, one may expect massive colonization by birch, willow, and grasses, the order of which determines the resulting composition of vegetation.

Rehabilitation Options

The Chugach N.F., Seward District, is faced with:

- a) Fuel hazard reduction
- b) Regeneration of both commercially operable sites and those primarily of amenity value
- c) Avoidance of redevelopment of flashy fuel

The scale of operation must be in the 5,000-10,000 acres per year range in the next few years. Thus, there is no opportunity for small scale trials to precede large scale operations. Successes and failures and their documentation early in the program will lead to improved results after the first year. All plans must accept the reality that manpower, equipment, and budgets are not at hand for rehabilitation with conventional approaches used to date. Moreover, low productivity of the best sites does not justify intense capital outlay solely for timber production; any rehabilitation program must contribute to timber, wildlife, fuel abatement, and visual value of the landscape, and be supported mutually.

Several options for managing vegetation on a large scale have been tested elsewhere, and appear adapted to this area. Their suitability for a particular prescription depends on what kind of stand is desired and several criteria for achievement. The following tables list the various approaches used to produce different types of stands, and how they may be evaluated according to the following criteria:

- 1) Operational feasibility
- 2) Risk of failure of conifer/habitat establishment
- 3) Reduction of present fuel
- 4) Reduction of future fuel
- 5) Cost
- 6) Environmental safety
- 7) Impact on site (potential long term productivity)
- 8) Visual impact

Table 1. Methods appropriate for regenerating spruce in beetle-killed stands near Cooper Landing according to eight criteria. Assumes salvage logging complete.

Approaches	Quantitative Rating by Criteria, by Number							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Summer burn, aerial seed	Good	High	Good	Variable	Low (on large scale high small)	Moderate	Moderate	High
Summer burn, plant	Fair*	Low	Good	Variable	Moderate	Moderate	Moderate	High
Spring burn, plant	Fair*	Moderate	Fair	Low	Moderate	Moderate	Low	High
Brown/summer burn, plant	Fair*	Lowest	Good	Good	High	Good	Medium	High
Herbicide, no burn, plant	Good*	Low	Poor	Fair	Moderate	Good	Low	Low
Salvage log, plant	Good*	High	Poor	Poor	Moderate	Good	Low	Low
Scarification	Poor*	Moderate	Good	Poor	High	Fair	High	High
Natural Regeneration	Good	High	Poor	Poor	Low	Good	Low	Low
Hand scalping, plant	Poor*	Moderate	Poor	Poor	High	Fair	Low	Low

*Scale limited by seedling availability/equipment/labor/materials

Criteria for Table 1 are given relative scores, based on ranges of costs and practical considerations for Cooper Landing. The feasibility constraints are primarily eased on availability of equipment, seedlings, and planters. Given a large enough scale, feasibility is much improved by inviting contractors from elsewhere. Safety is largely based on risk of fire escapement and personal injury from equipment or smoke. Chemical hazard to applicators or general public is negligible. The improved safety of brown and burn over burn only is conditioned by improved ability to burn under "safe" burning conditions. Improved safety is a matter of lower emissions and greater contrast in fuel conditions between the burn area and the area beyond. Documentation of assumptions is available in literature on file with State and Private Forestry (Dr. Ed Holsten) in Anchorage.

Logging impacts also vary, depending on season and freeze-up. Winter operations disturb the ground surface very little, but summer logging may or may not lead to substantial scarification and site impact. The latter can be augmented or not by design.

Logging also has an influence on fuel. Whole tree logging substantially removes fine fuel, and thus changes the risk of uncontrollable conflagration associated with dead grass thatch.

Table 2. Methods appropriate for regenerating mixed spruce/birch/willow
in salvage-logged beetle-killed spruce forests.

Approaches	Criteria							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Summer hot burn, aerial								
seed birch/willow/spruce	Good	High	Good	Variable	Low	Moderate	High	High
Summer burn, plant spruce	Fair*	Low	Good	Variable	Moderate	Moderate	High	High
Spring burn, plant spruce	Fair*	Moderate	Fair	Low	Moderate	Moderate	Low	High
Brown/burn, seed all spp.	Good	Mod/low	Good	Good	Low/Mod	Best	Medium	High
Desiccation/burn,								
seed all spp.	Poor*	High	Good	Poor	Low/mod	High	Moderate	High
Brown/burn, plant spruce	Fair*	Low	Good	Good	High	Good	Medium	High
Log, plant birch, spruce								
low density	Fair*	Moderate	Poor-	Poor	Moderate	Good	Low	Low
			Fair					
Scarification, plant								
spruce, nat'l birch	Poor*	Mod/low	Good	Poor	High	Fair	High	High
Nat'l regeneration,	Good	High	Poor	Poor	Low	Poorest	Low	Low
no site prep.								

*Scale Limited by availability of seedlings/equipment/labor/materials.

Tables 1 and 2 differ primarily in regard to whether inclusion of non-coniferous species, and broadening of goals to include moose browse enhancement, broadens the base for evaluating success. This set of practices may be judged advantageous according to whether either browse or timber or both goals are achieved, and the degree to which such values were present before insect attack and enhancement is now desired. If either is achieved, amenity values will also be enhanced, hence this set of options deals with multiple-use evaluation better than the others. In both set of practices, achievement levels (risk of failure; production of browse/timber) and the time needed to produce these values are the basis for the ratings. Obviously, the level of achievement expected will affect the interpretation of degree of success or failure (Criterion 2)

The final set of practices (Table 3) considers rehabilitation of non-commercial lands for amenity and wildlife values. Here, the goals are exclusively fuel reduction, avoidance of future fuel buildup, and wildlife habitat.

Table 3. Methods appropriate for rehabilitating non-commercial sites on which fuel hazard necessitates action. No logging values considered, no tree felling.

Approaches	Criteria							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Spring burn, seed willow	Good	Med/high	Good	Poor	Low	Moderate	Low	High
Spring burn, seed willow, birch	Good	Med.	Good	Poor	Low	Moderate	Low	High
Summer burn, seed hardwoods	Fair	Low	Good	Good	Low/mod	Moderate	High	High
Desiccate, summer burn, seed hardwoods	Fair*	Lowest	Good	Good	Moderate	Good	High	High

*Scale limited by availability of equipment/labor/materials.

Fuel break management

The explosive fuels condition near Cooper Landing and other developed areas has triggered a need for fuel breaks. Some of these are needed to protect from the heavy fuel represented by beetle-killed stands, others to protect from the flashy fuel resulting from opening up these stands.

Clearing and mechanical disturbance are both involved in fuel break construction. Clearcut strips with one or two strips to mineral soil are normally required. These strips have the potential to green up with grass. Along with residual fire fuels and dry ground litter, the grass thatch creates continuous flashy fuel. As long as grass is free to develop, there will remain a chronic problem with potential for spring fires.

Fire breaks can be renewed mechanically each spring, or they can be treated chemically so that they will not green up. The Forest Service has staff knowledgeable in the use of machinery for this purpose. Chemical reduction of green-up is most feasible with imazapyr (Arsenal®). This product will keep a site nearly free of green-up for more than one year in interior Alaska with rates of 8 oz/acre, or more. Imazapyr is moderately persistent in soil, and residues will remain in place. This has the combined effect of discouraging invader plants and assuring that the product does not leach into ground water. If it did enter ground water, its biological activity appears limited to green plants.

Use of specialty planting stock as a vegetation management tool

Rapidly developing herb cover has, in some instances elsewhere, been reforested successfully with large planting stock. An opportunity exists in the Seward District to test the hypothesis that large transplant

seedlings are more resistant to lodging than small container seedlings. There is also the rationale that, being several years older in equivalent age, they are further along in the competitive race, hence need less vegetation control.

Production of large transplants, and storing and shipping them, may not be feasible in a centrally located nursery in the sub-arctic. Small field transplant beds of 20 to 100 thousand seedlings would be possible on the types of soils observed near Cooper Landing.

Development of field transplant beds would be contingent on:

- 1) Having a supply of vigorous 1-0 seedlings
- 2) Having a site with large stumps removed and soil worked up, ideally with much of the organic layer incorporated
- 3) Ability to protect beds from animal damage and weeds. Weeding after the first few months could be done chemically, with hexazinone
- 4) Adequate fertilization. Soil tests would be appropriate.

All planting and applications could be done by hand. Lifting and planting could be done on the same day, with no need for storage. Some equipment would be desirable for lifting, and for machine transplanting. (Lifting bar; one row transplanter; tractor with compound low gear).

Chemical vegetation control products

Several of the practices include chemical products to control vegetation. The primary products relevant for these uses are:

Glyphosate (Roundup®, Accord®) for pre-burn or no-burn treatment of all grass, forb, and deciduous woody species. When used at full foliage development, the chemical will kill rhizomes and roots. Applied in early summer, it will desiccate herbs and top-kill woody species, which may then sprout. It has no residual biological activity, and is selective over spruce in fall. Toxicity is negligible. It is non-mobile in environment.

Hexazinone (Velpar®) for non-burn control of herbs and inhibition of some shrubs. Apply in spring, normally. Residual action in soil prevents rapid green-up. Hexazinone is selective on spruce, but may injure container 1-0 seedlings. Birch, spruce may seed in on treated areas. Residues are low in mobility, low in toxicity. Users of the 90% dry product should wear face masks to avoid inhaling irritating dust. Liquid product preferred, but flammable and perhaps costly to ship. Velpar ULW® is 75% active prilled product that mixes well with fertilizer.

Imazapyr (Arsenal®) for non-selective control of all vegetation in fire breaks. Soil residue is active for possibly a year or more. Residues are non-mobile, non-toxic. This is the only one of the prospective products whose residues in soil will injure spruce.

SUMMARY

The large-scale spruce beetle outbreak near Cooper Landing, AK, has created problems of timber salvage and fuel build-up on a large scale. Dealing with these by almost any approach will leave the Seward District of the Chugach N.F. with vegetation, development that will create future problems.

Grass invasion on rich sites will be a major factor in success of reforestation efforts. The threat of grass increases with time as spruce mortality progresses. Logging and rehabilitation before grass is established will probably be the most feasible approach. We anticipate that the order in which problems develop, in increasing order of difficulty are: Early in the epidemic, dry site (little problem) is less than the same site 2-3 years into the epidemic which is less than 3+ years into epidemic, when heavy mortality occurs. Presence of birch appears to enhance grass and increases general severity of the problem. Scarification enhances grass, alder, and birch on good sites. Degree of physical disturbance influences probability of grass invasion, primarily, but also alder and birch. Use of vegetation control products can help reduce fire hazards and competition without physical disturbance.

Prescriptions rely on fire, machinery, chemicals, and planting or seeding. Each is arrayed by eight criteria for three sets of dominant land use goals. Where planting is involved, the use of large bare-root seedlings may be justified. Test data for chemicals are being developed. Developmental work on large seedlings is needed to reduce reliance on intensive site preparation.